

Descriptions of new taxa of the genus *Agrodiaetus* HÜBNER, [1822] based on karyotype investigation

(Lepidoptera, Lycaenidae)

by

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Summary: The karyotypes of the following taxa of the genus *Agrodiaetus* from Turkey and Kazakhstan have been investigated: *A. ripartii colemani* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Shymkentskaya oblast', Ugamskij Khrebet), *A. ripartii sarkani* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau), *A. ripartii ovchinnikovi* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Vostochno-Kazakhstanskaya oblast', Zyryanovskij raion), *A. alcestis karacetinae* LUKHTANOV & DANTCHENKO subspec. nov. (n = 19; Turkey, Hakkari, Dez valley), *A. damocles kanduli* DANTCHENKO & LUKHTANOV subspec. nov. (n = 25; Turkey, Erzincan, Munzur Daglari Mts), *A. putnami* DANTCHENKO & LUKHTANOV spec. nov. (n = 26; Turkey, Erzurum, 8 km W Kayabasi), *A. sigberti* OLIVIER, VAN DER POORTEN, PUPLESIE, DE PRINS & WIEMERS, 2000 (n = 28 and n = 29), *A. bilgini* DANTCHENKO & LUKHTANOV spec. nov. (n = 25; Turkey, Gümüşhane, 20 km S Torul), *A. haigi* DANTCHENKO & LUKHTANOV spec. nov. (n = 25; Turkey, Van, 34 km N Çatak), *A. pierceae* LUKHTANOV & DANTCHENKO spec. nov. (n = 22; Turkey, Van, Güzeldere Geçidi) and *A. surakovi sekercioglu* DANTCHENKO & LUKHTANOV subspec. nov. (n = 50; Turkey, Van, 34 km N Çatak). The taxonomic position of the investigated taxa is discussed.

Zusammenfassung: Die Karyotypen der folgenden Taxa der Gattung *Agrodiaetus* aus der Türkei und aus Kasachstan wurden untersucht: *A. ripartii colemani* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Shymkentskaya oblast', Ugamskij Khrebet), *A. ripartii sarkani* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau), *A. ripartii ovchinnikovi* LUKHTANOV & DANTCHENKO subspec. nov. (n = 90; Kazakhstan, Vostochno-Kazakhstanskaya oblast', Zyryanovskij raion), *A. alcestis karacetinae* LUKHTANOV & DANTCHENKO subspec. nov. (n = 19; Turkey, Hakkari, Dez valley), *A. damocles kanduli* DANTCHENKO & LUKHTANOV subspec. nov. (n = 25; Turkey, Erzincan, Munzur Daglari Mts), *A. putnami* DANTCHENKO & LUKHTANOV spec. nov. (n = 26; Turkey, Erzurum, 8 km W Kayabasi), *A. sigberti* OLIVIER, VAN DER POORTEN, PUPLESIE, DE PRINS & WIEMERS, 2000 (n = 28 and n = 29), *A. bilgini* DANTCHENKO & LUKHTANOV spec. nov. (n = 25; Turkey, Gümüşhane, 20 km S Torul), *A. haigi* DANTCHENKO & LUKHTANOV spec. nov. (n = 25; Turkey, Van, 34 km N Çatak), *A. pierceae* LUKHTANOV & DANTCHENKO spec. nov. (n = 22; Turkey, Van, Güzeldere Geçidi) and *A. surakovi sekercioglu* DANTCHENKO & LUKHTANOV subspec. nov. (n = 50; Turkey, Van, 34 km N Çatak). Die taxonomische Stellung der untersuchten Taxa wird diskutiert.

Introduction

The genus *Agrodiaetus* HÜBNER, [1822] is one of the most complicated groups of the Palearctic Lepidoptera. It includes numerous species, subspecies and forms with uncertain taxonomic status. Most of these taxa show little differentiation in colour and wing pattern. The genitalia of the species exhibit similar structures. In view of strong intrapopulation polymorphism, in certain cases, it is virtually impossible to separate sympatric species. The assignment of allopatric forms is an even more complicated problem because data on the real population structure of the species are very limited, and the geographical variability of the standard morphological characters is not always correlated. In general, such forms can be interpreted either as individual species with limited distribution or as local populations of the widely distributed species. This problem is still under discussion.

Although the morphology of different species of the genus is quite similar, the species show strong divergence in their karyotype. According to DE LESSE (1960a) the chromosome number varies in the genus from $n = 10$ (*A. posthumus* CHRISTOPH, 1877) up to $n = 123-125$ (*A. dolus* HÜBNER, [1823]). Therefore, it is not surprisingly that the karyotype characters (the chromosome number and the karyotype structure) are widely applied in the taxonomy of *Agrodiaetus*. Such an approach was first suggested by DE LESSE (1957) and later developed by other authors (LUKHTANOV, 1989; HESSELBARTH et al., 1995; MUNGIURA et al., 1995; DANTCHENKO, 1997; KANDUL, 1997; OLIVIER et al., 1999).

The discussion of the karyotype significance for the taxonomy of the *Agrodiaetus* species complex is out of scope of the current paper, and it will be done separately (LUKHTANOV & DANTCHENKO, in prep.). Nevertheless we will highlight here the main characteristics of our approach, which implies using the karyology data as a taxonomic tool.

It is well known that the chromosome rearrangements could be the cause of hybrid sterility, i.e. the basis of the reproductive isolation mechanism (for review see: KING, 1993). However, this is not always true, and in some cases the heterozygosity for chromosome rearrangements does not result in sterility. In fact, there is no well-established rule, which determines, what types of the chromosome rearrangements leads to meiosis violation and, correspondingly, to the fertility reduction. Specific study is necessary for each separate case. To the best of our knowledge, up to now no data of this kind concerning the *Agrodiaetus* species-complex are available.

In spite of this limitation, even in the absence of specific data on the role of the chromosome rearrangement in a post-zygotic reproductive isolation, the karyotype could be a powerful taxonomic tool for the following reasons:

1. Karyotype characters are stable within species. Analysis of the available literature reveals that the predominating majority of well-studied species show either no or very limited chromosome variability (for a review see: KING, 1993). There are a few species with variations of more than 2-4 elements in the basic chromosome set. In rare cases, larger variability is determined by the presence of additional B-chromosomes, which do not belong to the basic set (PROKOFEVA-BELGOVSKAYA, 1986), or interspecific hybridization (VORONTSOV, 1999; FREGDA &

NARAIN, 2000). Also, the results reported in some papers may be due to non-critical interpretation of the cytological data.

Thus, even slight differences in the basic chromosome number between two geographical or ecological forms should be treated as an indirect, but strong evidence against their conspecificity.

2. Each separate chromosome rearrangement is a discrete morphological character, and, hence, it can be used in taxonomic analyses. Using a popular taxonomic test of comparing parameters of variability within the group and between different groups, one can make a hypothesis on the taxonomic status of the groups under consideration. It is clear that using karyological data in the taxonomic analysis can be more effective for those groups, where karyotype differentiation is more pronounced than the morphological one.

From the first steps, the *Agrodiaetus* species-complex was apprehended as an esoteric subject (ALPHERAKY, 1881: 391–392). This peculiarity prevented this complex from taxonomic inflation, as compared, for example, to *Celastrina argiolus* or *Lysandra coridon* complexes, which were treated as obvious subjects. The fact of such synonymic congestion is revealed clearly from the data base published by BRIDGES (1988:II, 22–23, 66–67).

In the middle of the 1970s, the *Agrodiaetus* species-complex stopped to be esoteric, which resulted in the appearance of works with numerous new taxa descriptions (see review of HÄUSER & ECKWEILER, 1997 and recent papers of CARBONELL, 1997, 1998a, 2000, 2001; CARBONELL & NADERI, 2000; ECKWEILER, 1998; ECKWEILER & TEN HAGEN, 1998; SCHURIAN & TEN HAGEN, 2001; SCHURIAN & ECKWEILER, 1999; SKALA, 2001; TEN HAGEN, 1999; TEN HAGEN & SCHURIAN, 2000).¹

With a few exceptions concerning morphometry (CARBONELL, 1994, 1996, 1998, 2001), the original descriptions declare indistinct and often changeable differences in colour and design of the wings. The descriptions could be classified as formal, i.e., available from the point of view of formal recommendation of ICZN (1999), but insufficient to determine the taxa. No new idea was proposed on the rearrangement of the complex. In fact, the genus *Agrodiaetus* is now in the state of a structural chaos, close to the situation before FORSTER's (FORSTER, 1956, 1960–1961) time. In this connection, each new formal description makes the situation for the whole group even worse.

We cannot exclude that most of the newly described nominal taxa are valid and reflect the real diversity of this group. However, it should be mentioned that most descriptions are based on the author's intuition and so called "taxonomical feeling" and do not contain structured and testable parameters of new taxa. In the absence of testable characteristics, the acceptability of the new taxa by the lepidopterists' community is based rather on subjective opinions of experts than on objective evidences.

1 We will disregard some papers (KOÇAK, 1983; KOÇAK & KEMAL, 2001a, 2001b), which are unsatisfactory from the methodological point of view. The propositions, ill-posed in this works, can not be tested (verified or falsified) in principle and contain logical contradictions: "excessive denotation", "error in division of denotation" etc.

We have the opinion to treat such kind of work out of contemporary scientific paradigm. Interestingly, this work itself (KOÇAK, 1983) became now a subject of specific investigation (CARBONELL, 2001).

In fact, this situation is due to the following reasons. First, the characters commonly used for description of new taxa cannot work properly in such a congested taxonomic space of a very complicated group. In other words, in the frame of traditional conception of the description procedure, the number of taxa of the species rank is too large. The second reason is lack of conventional concept of species, which could be applied for description of new taxa within *Agrodiaetus* species-complex.

Both these reasons do not allow us to structure the group, even in preliminary terms. Such a situation is not unique. It can be also found in other groups of species, e.g., genera *Pseudochazara*, *Karanasa* etc. Thus, elucidation of new trustful characters and elaboration of the procedure of using these characters for the group under discussion is crucially important.

Meanwhile, the karyotype characters undoubtedly should be regarded as distinct and testable ones. Both the analysis of the works cited above and our own long-term *Agrodiaetus* experience clearly show that all the taxonomic statements may be of any sense, only if they agree with karyological data. This fact is accepted by all experts in the field. It is true not only for the so called "brown" complex, but also for the species with blue-coloured males. From the methodological point of view, the karyologic data must precede the description of new taxa, because it allows one to avoid the "problem of a non-karyotyped holotype". According to contemporary paradigm, the holotype is a standard for the verification procedure. If no reliable characteristics are attributed to the standard, it loses its main function.

To sum up, in this work we have to suggest for the expert community involved in the studies of *Agrodiaetus* the following principles:

- 1) each new description must be based on a karyologically investigated holotype;
- 2) tissues of each holotype (minimal a leg) must be fixed in 100% ethanol for the future DNA analysis. The analysis of the nucleotid sequences is a powerful tool to reveal the phylogenetic relationship among taxa. In the genus *Agrodiaetus*, in which the number of suitable taxonomical characters is restricted, the DNA analysis is especially important.

In this paper we are describing 4 new species and 6 new subspecies of *Agrodiaetus* basing mainly on the study of their karyotype as well as on other traits of their morphology, ecology and distribution. Phylogenetic relations of the described taxa based on molecular investigations will be discussed in a separate paper (KANDUL et al., in press).

Materials and methods

Insects

Population samples of different taxa of the genus *Agrodiaetus* were collected in the period of 2000–2001. Fresh (not worn) adult males were used to investigate the karyotypes. After cap-

turing a butterfly in the field, it was placed into a glassine envelope for 1–2 hours to keep it alive until we were ready to process it. Then the butterfly was killed by pinching it firmly on the thorax. Immediately after killing it, the testes were removed from the abdomen and placed into a small 0.5 ml vial with a freshly prepared Carnoy fixative (ethanol and glacial acetic acid, 3:1). Then each wing was carefully removed from the body using two sets of forceps: (i) a coarse or “flattened” set to hold the body and (ii) a much finer set to pinch off the wings. The wingless body was placed into a plastic, 2 ml vial with pure 100% ethanol. Each vial with ethanol has already been numbered. This ID number was also used to label a vial with a Carnoy fixative and a glassine envelope in which to preserve the wings. Thus, each specimen was individually fixed. After the fixation we had three components collected for each butterfly, each of which was identified by a common ID number: (a) a vial containing the butterfly testes (for karyotype analysis), (b) a vial containing the butterfly wingless body (for DNA analysis) and (c) a glassine envelope containing the wings. In most cases, females were not included in the type-series and in the descriptions of new taxa because we failed females in copula with karyotyped males.

However, we include in the type series female specimens from the populations, which seem to be apparently homogeneous from zoogeographic and ecological point of view.

Chromosome preparation and karyotyping

Testes were stored in the fixative for 1–12 months at +4 °C. Then the gonads were stained in 2% acetic orcein for 30–60 days at +18–20 °C. Different stages of male meiosis were examined in a light microscope Amplival, Carl Zeiss. We have used an original two-phase method of chromosome analysis (LUKHTANOV & DANTCHENKO, 2002). In the first phase, the stained testes were placed into a drop of 40% lactic acid on a slide, the gonad membranes were torn apart using fine needles and intact spermatocysts were removed and transferred into another drop of 40% lactic acid. During the metaphase I stage, each spermatocyst is a regular sphere and consists of 64 spermatocytes. Intact spermatocysts were studied and photographed, at first by using 40× and 60× objectives and then 100× objective. In the second phase, different stages of chromosome spreading were observed using a slight, gradually growing pressure on the coverslip. The second phase was very useful for studying the bivalent structure, identifying bivalents and multivalents, and solving controversial cases of touched or overlapped bivalents. Scaling up the pressure on the coverslip, we were able to manipulate with chromosomes by changing their position and orientation on the slide.

It should be noted that the male meiosis in Lepidoptera is a dichotomous process leading to eupyrene (fertile) and apyrene (anucleate, non-fertile) spermatozoa (FRIEDLÄNDER, 1997). The eupyrene and apyrene primary spermatocytes differ fundamentally in structure and function (for a review see WOLF et al., 1987; WOLF, 1994). Our study deals only with eupyrene meiosis. Negatives and photographs of the studied chromosome preparations are kept in the Department of Entomology of the University of St. Petersburg, Russia. The set specimens of the donor butterflies (the butterfly wingless bodies in ethanol and wings in glassine envelopes) are kept in the DNA and Tissues Collection of the Museum of Comparative Zoology (Harvard University, Cambridge, MA, USA).

Abbreviations

ca	circa, approximately determined chromosome number
ICZN	International Code of Zoological Nomenclature
MI	first metaphase of meiosis
MII	second metaphase of meiosis
MCZH	Museum of Comparative Zoology (Harvard University, Cambridge, MA, USA)
MNHN	Muséum National d'Histoire Naturelle (Paris, France).
n	haploid chromosome number
SPSU	St. Petersburg State University, St. Petersburg, Russia
ZSSM	Zoologische Staatssammlung, München

Descriptions of new taxa

1a. *Agrodiaetus ripartii colemani* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: No NK00P822, n = 90; Kazakhstan, Shymkent'skaya oblast', Ugamskij Khrebet, Saryagyr, 1600 m, 25.VI.2000, V. LUKHTANOV leg., in MCZH.

Paratypes: 4 ♂♂, Kazakhstan, Shymkent'skaya oblast', Ugamskij Khrebet, Saryagyr, 1600 m, 25.VI.2000, V. LUKHTANOV leg., in SPSU. 15 ♂♂, 4 ♀♀, [Uzbekistan], Tian-Shan occ., Ms Bolshoj Tshimgan, 1500–1800 m, 8.–12.VIII.1934, L. SHELUZHKO & N. PAVLITZKAYA leg., in ZSSM; 12 ♂♂, 3 ♀♀, Kazakhstan, Shymkent'skaya oblast', Khrebet Syrdarjinskij Karatau, Minzhilgi, 1200–1400m, 20.–25.VI.1988, 25.VI.–7.VII.1989, A. & V. LUKHTANOV leg., in SPSU. 1 ♂, 2 ♀♀, Uzbekistan. W. Tian-Shan, Pskemskij Mts., Yangi-Bazar, 26.VII.1965, leg. A. KUZJAKIN, in State Darwin Museum, Moscow, Russia.

Description

♂. Forewing length 14–17 mm.

Upperside: Ground colour is light brown with light yellow shimmer and with darker veins. Discoidal, submarginal and antemarginal marking completely absent on both fore- and hindwings. Forewing with a good developed sex brand and scale tuft, in most of the specimens with 2–4 small thin white strokes on costal margin. Fringes gray.

Underside: Ground colour is yellowish brown. Greenish blue basal suffusion is very light, almost absent. Basal black spots present on hindwings, but absent on forewings. Discoidal and postdiscal black marking well developed on both fore- and hindwings. Submarginal and antemarginal marking completely absent on forewings. On hindwings submarginal marking strongly reduced, nearly absent; antemarginal marking is presented by small inconspicuous strokes. White streak on hindwings clearly visible. Fringes gray.

♀. Forewing length 14–15 mm.

Upperside: Ground colour is brown, darker than in males, with darker veins. Discoidal spot is developed. Submarginal and antemarginal marking completely absent on both fore- and hindwings. The white strokes on costal margin of the forewing are weaker developed than in males or absent. In few females there are small yellowish lunules in tornal part of the hindwing. Fringes light gray to white.

Underside: Ground colour brownish, much darker than in the male. The marking of the fore- and hindwings as in the males, but more contrasting. White streak on hindwings is clearly widening to the outer margin. Fringes light gray to white.

Karyotype

From 5 fixed specimens only one male (sample NK00P822) showed good MI cells. This specimen was designated as holotype and was also used for molecular investigations (KANDUL et al., in press). In this specimen, in numerous MI cells we could approximately count ca 88–90 bivalents. These count were done with approximation due to the overlapping of some bivalents. However in two MI plates the chromosome number was precisely determined as $n = 90$. In the MI karyotype there are two distinctly large oval bivalents, the second of which is about 60–70% the size of the first one. The rest of bivalents are dumb-bell shaped, small and of gradually diminishing size.

This chromosome number and the karyotype structure are identical to those found by DE LESSE in *A. ripartii* (FREYER, 1830) from France, Spain and Turkey (DE LESSE, 1960a; 1960b; 1961), by KANDUL in *A. ripartii budashkini* (KOLEV & DE PRINS, 1995) from the Crimea (KANDUL, 1997) and by PUPLESIENE in *A. ripartii* from Greece (COUTSIS et al. 1999).

Illustrations

Fine pictures of this taxon are given in the work of DANTCHENKO (2000, pl. 79, figs 37–39, as *Agrodiaetus ripartii* ssp.).

Differential diagnosis

When compared to European and Turkish populations of *A. ripartii* FREYER, 1830; *montanesa* GOMEZ-BUSTILLO, 1971; *mozuelicus* AGENJO, [1973]; *agenjoi* FORSTER, 1965; *ripartii* BOISDUVAL, 1832; *exuberans* VERITY, 1926; *pelopi* BROWN, 1976; *paralcestis* FORSTER, 1960 and *budashkini* KOLEV & DE PRINS, 1995, the new subspecies has the following differences:

Underside of wings is lighter, yellowish brown. Greenish blue basal suffusion is very light, nearly absent. The marking of the wing's underside (including the white streak on hindwing) is much less contrasting. Spots on the hindwing's underside are very small (half the size than on the forewing).

The greatest differences of *A. ripartii colemani* from other taxa were found in the nucleotid sequence of the mitochondrial genes *cytochrome oxidase I (COI)* and *cytochrome oxidase II (COII)* (KANDUL et al., in press). According to this mtDNA data set, the degree of mtDNA differentiation between *A. ripartii colemani* and other subspecies of *A. ripartii* is more than, for examples, the divergence between *A. ripartii paralcestis* and *A. demavendii* (PFEIFFER, 1938).

However, we prefer to consider *A. ripartii colemani* as conspecific with other subspecies of *A. ripartii* taking into account the similarity of their ecology and the identity of the chromosome number.

Distribution

The distribution of the butterflies with the phenotypical traits of *A. ripartii colemani* is confined to the Western Tian-Shan in South Kazakhstan and Uzbekistan. It includes Khrebet Syrdarjinskij Karatau, Khrebet Karzhantau, Ugamskij Khrebet, Pskemskij Khrebet, Chatkalskij Khrebet and Talasskij Khrebet.

Ecology

The butterflies fly on relatively humid meadows and steppes in mountains from 1000 up to 2500 m a.s.l. Flight period: from late June to the mid of August. The butterflies are associated with *Onobrychis spec.* which is probably the food plant of larvae.

Etymology

Mr. JAMES COLEMAN (Harvard University, USA) was an active member in our expedition to Kazakhstan in 2000 and zealous Lab worker sequencing DNA inside of the Lycaenid DNA project.

Notes

1. The descriptions of other Central Asian taxa of the *Agrodiaetus ripartii* complex, which most probably consists of several species, will be possible only after studying the karyotypes.
2. It is well known that the separation of species in the monomorphic *Agrodiaetus* group (in which the wings of both sexes are covered with brown scales) is practically impossible without their karyotyping. However, *Agrodiaetus ripartii tengritaghius* (KOÇAK & KEMAL, 2001a) was described recently. The description was based on the holotype labeled as "Kazakhstan" and paratypes from Kurдай Pass and Trans-Ili-Alatau Mts (SE Kazakhstan). Due to missing the karyotype data and indistinct TL, we are forced to treat it as a species inquirenda (sensu ICZN, 1999) and to ignore it.

1b. *Agrodiaetus ripartii sarkani* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: No NK00P829, n = 90, Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau, Andreevskij raion (Kabanbai), Kolbai vic., 800 m, 5.VII.2000, V. LUKHTANOV leg., in MCZH.

Paratypes: 4 ♂♂ (NK00P828, NK00P830–832), Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau, Andreevskij raion (Kabanbai), Kolbai vic., 800 m, 5.VII.2000, V. LUKHTANOV leg., in MCZH. 12 ♂♂, 3 ♀♀, Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau, Andreevskij raion (Kabanbai), Kolbai vic., 800 m, 5.VII.2000, V. LUKHTANOV leg., in SPSU. 6 ♂♂ (NK00P838–843, n = 90), Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau, Andreevskij raion (Kabanbai), Ekpindy vic., 800 m, 6.VII.2000, V. LUKHTANOV leg., in MCZH. 25 ♂♂, 8 ♀♀, Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau, Andreevskij raion (Kabanbai), Ekpindy vic., 800 m, 6.VII.2000, V. LUKHTANOV leg., in SPSU. 8 ♂♂ (NK00P844–851, n = 90), E. Kazakhstan, Semipalatinskaya oblast', Tarbagatai Range (SW part), 20 km S Taskesken, 500 m, V. LUKHTANOV leg., in MCZH. 21 ♂♂, 5 ♀♀, E. Kazakhstan, Semipalatinskaya oblast', Tarbagatai Range (SW part), 20 km S Taskesken, 500 m, V. LUKHTANOV leg., in SPSU.

Description

♂. Forewing length 14–17 mm.

Upperside: Ground colour is brown with very light yellow shimmer and with darker veins. Discoidal, submarginal and antemarginal marking completely absent on both fore- and hindwings. Forewing with a good developed sex brand and scale tuft. Fringes gray.

Underside: Ground colour is yellowish brown. Greenish blue basal suffusion is light. Basal black spots present on hindwings, but absent on forewings. Discoidal and postdiscal black

marking well developed on both fore- and hindwings. Submarginal and antemarginal marking completely absent on forewings. On hindwings submarginal and antemarginal marking reduced. White streak on hindwings clearly visible. Fringes gray.

♀. Forewing length 14–15 mm.

Upperside: Ground colour is brown, darker than in the males, with darker veins. Discoidal spot developed. Submarginal and antemarginal marking completely absent on both fore- and hindwings. Fringes light gray to white.

Underside: Ground colour brownish. The marking of the fore- and hindwings as in the males, but more contrasting. White streak on hindwings is clearly widening to the outer margin. Fringes light gray to white.

Karyotype (fig. 1)

Chromosome number $n = 90$ was determined in three males: in the holotype and in two paratype (samples NK00P829 (3 MI), NK00P838 (Ekpindy, 6 MI) and NK00P848 (Taskesken, 4 MI) accordingly). Additionally, in two specimens from Ekpindy the chromosome numbers were approximately determined as $n = ca\ 90$. The MI karyotype showed two large oval bivalents and 88 small bivalents. The area of the bivalent 1 was 1.5–1.6 times as large as that of bivalent 2. The rest of bivalents were dumb-bell shaped, small and of gradually diminishing size. In intact MI cells the small bivalents formed a regular circle, in which the largest bivalent 1 occupied a position in the centre of the circle, and the bivalent 2 was always situated near the bivalent 1. This highly ordered arrangement of bivalents was discussed in detail in another paper (LUKHTANOV & DANTCHENKO, 2002).

In *A. ripartii sarkani* the chromosome number and the karyotype structure are identical to those found by DE LESSE in *A. ripartii* from France, Spain and Turkey (DE LESSE, 1960a; 1960b; 1961a), by KANDUL in *A. ripartii budashkini* (KOLEV & DE PRINS, 1995) from the Crimea (KANDUL, 1997), by PUPLESIENE in *A. ripartii* from Greece (COUTSIS et al., 1999) and in *A. ripartii colemani* (our data, see above).

Differential diagnosis

The new subspecies differs from *A. ripartii colemani* by the wing's underside, which is more contrasting with better developed marking. It differs from all European and Turkish populations of *A. ripartii* by the wing underside, which has more warm, light brownish coloration. The marked differences of *A. ripartii sarkani* from *A. ripartii colemani* and from European and Turkish populations were found in the nucleotid sequence of the mitochondrial genes *cytochrome oxidase I (COI)* and *cytochrome oxidase II (COII)* (KANDUL et al., in press).

Distribution

The distribution of the butterflies with the phenotypical traits of *A. ripartii sarkani* is confined to the Dzhungarian Alatau and Alakol Lake basin in the Eastern Kazakhstan, probably also to the adjacent regions of the Western China.

Ecology

The butterflies were found to fly on dry meadows and steppes from lowlands of the Alakol plane up to 1500 m in the mountains. Flight period: from mid-June to mid-July. Unlike to other subspecies of *A. ripartii*, the butterflies were associated with *Hedysarum* spec. (not *Onobrychis*) which is probably the food plant of the larvae.

Etymology

Mr. SARKAN, (student of Istanbul University, Turkey) was an active member in our *Agrodiaetus*-expedition, and accompanied us during our trip to Eastern Turkey in 2001.

1c. *Agrodiaetus ripartii ovchinnikovi* Lukhtanov & Dantchenko **subspec. nov.**

Holotype ♂: No 1986-142, n = 90, Kazakhstan, Vostochno-Kazakhstanskaya oblast', Zyr-
yanovskij raion, Kremnyukha, 450 m, 2.VII.1986, V. LUKHTANOV leg., in SPSU.

Paratypes: 30 ♂♂, 2 ♀♀, Kazakhstan, Vostochno-Kazakhstanskaya oblast', Zyr-
yanovskij raion, Kremnyukha, 450 m, 2.VII.1986, V. LUKHTANOV leg., in SPSU. 8 ♂♂, 2 ♀♀, Kazakhstan, Vos-
tochno-Kazakhstanskaya oblast', Kurtchumskij raion, Kurtchumskij Range, 900 m, 14.VII.1986,
V. LUKHTANOV leg., in SPSU. 12 ♂♂, 4 ♀♀, Kazakhstan, Vostochno-Kazakhstanskaya oblast',
Zyr-yanovskij raion, Stolboukha, 450 m, 14.-30.VII.1985, V. LUKHTANOV leg., in SPSU.

Description

♂. Forewing length 14-17 mm.

Upperside: Ground colour is brown with darker veins. Discoidal, submarginal and ante-
marginal marking completely absent on both fore- and hindwings. Forewing with a good devel-
oped sex brand and scale tuft. Fringes light gray.

Underside: Ground colour is light brownish. Greenish blue basal suffusion is present. Basal
black spots present on hindwings, but absent on forewings. Discoidal and postdiscal black
marking well developed on both fore- and hindwings. Postdiscal spots on the hindwing's un-

Figures 1-6. Karyotypes of *Agrodiaetus*.

Fig. 1: *Agrodiaetus ripartii sarkani* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: No NK00P829, n = 90, Kazakhstan, Taldy-Kurganskaya oblast', Dzhungarian Alatau,
Andreevskij raion (Kabanbai), Kolbai vic., 800 m, 5.VII.2000, V. LUKHTANOV leg., in MCZH.

M I plate, squash preparation; n = 90. Arrow indicates two overlapped bivalents.

Fig. 2: *Agrodiaetus ripartii ovchinnikovi* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: No 1986-142, n = 90, Kazakhstan, Vostochno-Kazakhstanskaya oblast', Zyr-
yanovskij raion, Kremnyukha, 450 m, 2.VII.1986, V. LUKHTANOV leg., in SPSU. n = 90.

Metaphase I plate in intact spermatocyte. n = 90. The largest bivalents occupy the position in the
centre of the circle metaphase plate.

Fig. 3: *Agrodiaetus alcestis karacetinae* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: specimen No 92024, n = 19, Turkey, Hakkari, Dez valley, 1500 m, 19 July 1992; leg.
H. v. OORSCHOT, H. v. d. BRINK, D. v. d. POORTEN & W. DE PRINS, in the collections of the Institute of
Systematic and Population Biology (Zoological Museum), Amsterdam, the Netherlands.

M I plate, squash preparation; n = 19.

Fig. 4: *Agrodiaetus damocles kanduli* DANTCHENKO & LUKHTANOV **subspec. nov.**

Holotype ♂: No VL01L180, n = 25, Turkey, Prov. Erzincan, Munzur Daglari Mts, Yildiz, 39°35'N,
39°57'E, 1700 m, 17.VII.2001, A. DANTCHENKO leg., in MCZH.

M I plate, squash preparation, n = 25.

Fig. 5: *Agrodiaetus putnami* DANTCHENKO & LUKHTANOV **spec. nov.**

Holotype ♂: No VL01L416 in MCZH, n = 26, Turkey, Prov. Erzincan, 8 km W Kayabasi, 39°51'N,
41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in MCZH.

M I plate, squash preparation, n = 26.

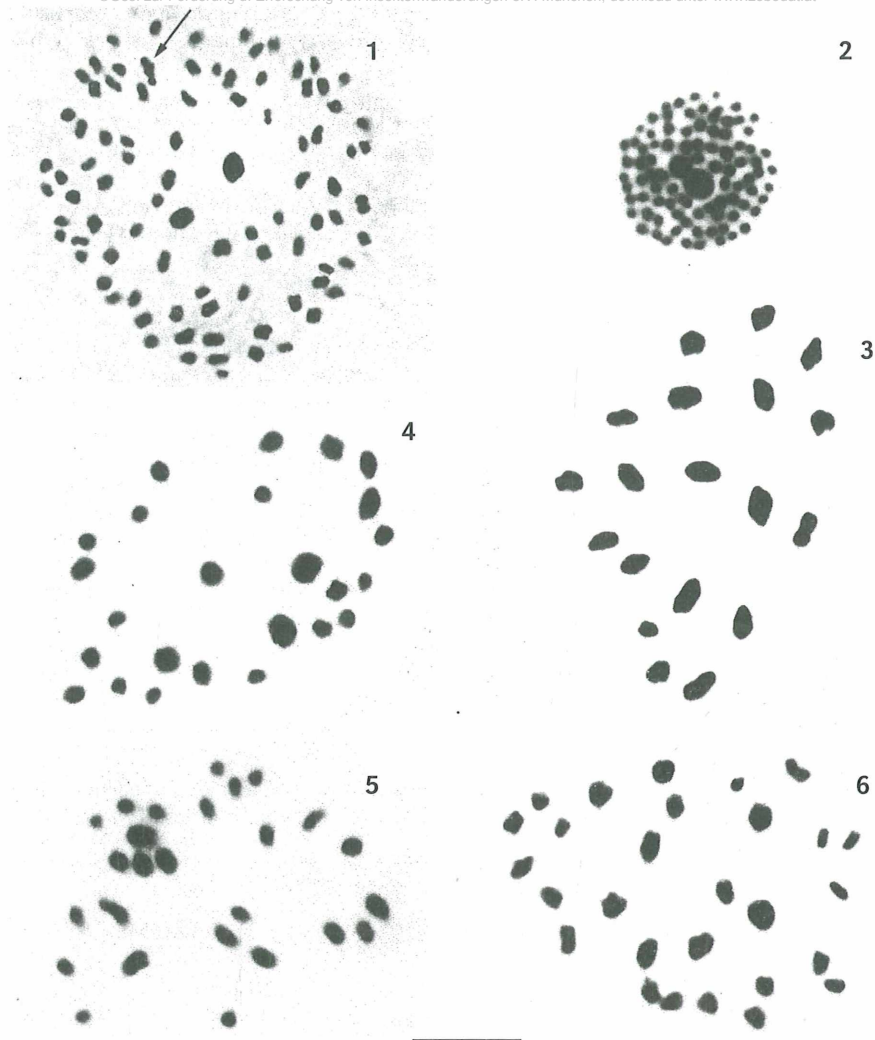


Fig. 6: *Agrodiaetus sigberti* OLIVIER, VAN DER POORTEN, PUPLESIENE, DE PRINS & WIEMERS, 2000
 No 94/125 Turkey, Nigde province, Aladaglari, 15 km SE Çamardı, 1800–2100 m, St. 2009,
 30.VII.1994, leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS, Paratypus.
 M I plate, squash preparation; n = 28.
 Bar represents 5 μ m in figs 1–10.

derside relatively large. Submarginal and antemarginal marking strongly reduced, practically absent on forewings. On hindwings submarginal and antemarginal marking reduced. White streak on hindwings good developed. Fringes light gray.

♀. Forewing length 14–15 mm.

Upperside: Ground colour is brown, darker than in the males, with darker veins. Discoidal spot developed. Submarginal and antemarginal marking completely absent on both fore- and hindwings. Fringes light gray to white.

Underside: Ground colour brownish, much darker than in the male. The marking of the fore- and hindwings as in the males, but more contrasting. White streak on hindwings is clearly widening to the outer margin. Fringes light gray to white.

Karyotype (fig. 2)

Chromosome number $n = 90$ was precisely determined in two males: in the holotype (sample VL1986–142, 2 MI studied) and the paratype (sample VL1986–152, Kurtchumskij Range, 2 MI studied). Additionally, in 7 specimens from Kremnyukha and in 2 males from Stolboukha the chromosome numbers were approximately determined as $n = ca\ 85–90$. The MI karyotype showed two large oval bivalents and 88 small bivalents. The area of the bivalent 1 was 1.5–1.6 times as large as that of bivalent 2. The rest of bivalents were dumb-bell shaped, small and of gradually diminishing size. In intact MI cells, the small bivalents formed a regular circle, in which the largest bivalent 1 occupied a position in the centre of the circle, and the bivalent 2 was always situated near the bivalent 1.

The chromosome number and the karyotype structure are identical in *A. ripartii ovchinnikovi* to those found by DE LESSE in *A. ripartii* from France, Spain and Turkey (DE LESSE, 1960a; 1960b; 1961a), by KANDUL in *A. ripartii budashkini* (KOLEV & DE PRINS, 1995) from the Crimea (KANDUL, 1997), by PUPLESIENE in *A. ripartii* from Greece (COUTSIS et al., 1999) and by us in *A. ripartii colemani* and *A. ripartii sarkani* (see above).

Differential diagnosis

A. ripartii ovchinnikovi differs by the dark coloration of the wing's upper- and underside and by the large postdiscal spots on the hindwing's underside. In other subspecies of *A. ripartii* the postdiscal spots are smaller or reduced.

Distribution

The distribution of the butterflies with the phenotypical traits of *A. ripartii ovchinnikovi* is confined to Altai Mts.

Figures 7–10. Karyotypes of *Agrodiaetus*.

Fig. 7: *Agrodiaetus bilgini* DANTCHENKO & LUKHTANOV spec. nov.

Holotype ♂: No VL01Q140 in MCZH, $n = 25$, Turkey, Prov. Gümüşhane, 20 km S Torul, 40°23'N; 39°19'E; 1300 m, 13.VII.2001, A. DANTCHENKO leg., in MCZH.

Prometaphase I spermatocyte, squash preparation; $n = 25$.

Fig. 8: *Agrodiaetus haigi* DANTCHENKO & LUKHTANOV spec. nov.

Holotype ♂: No VL01L220, $n = 25$, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH.

MI plate, squash preparation; $n = 25$.

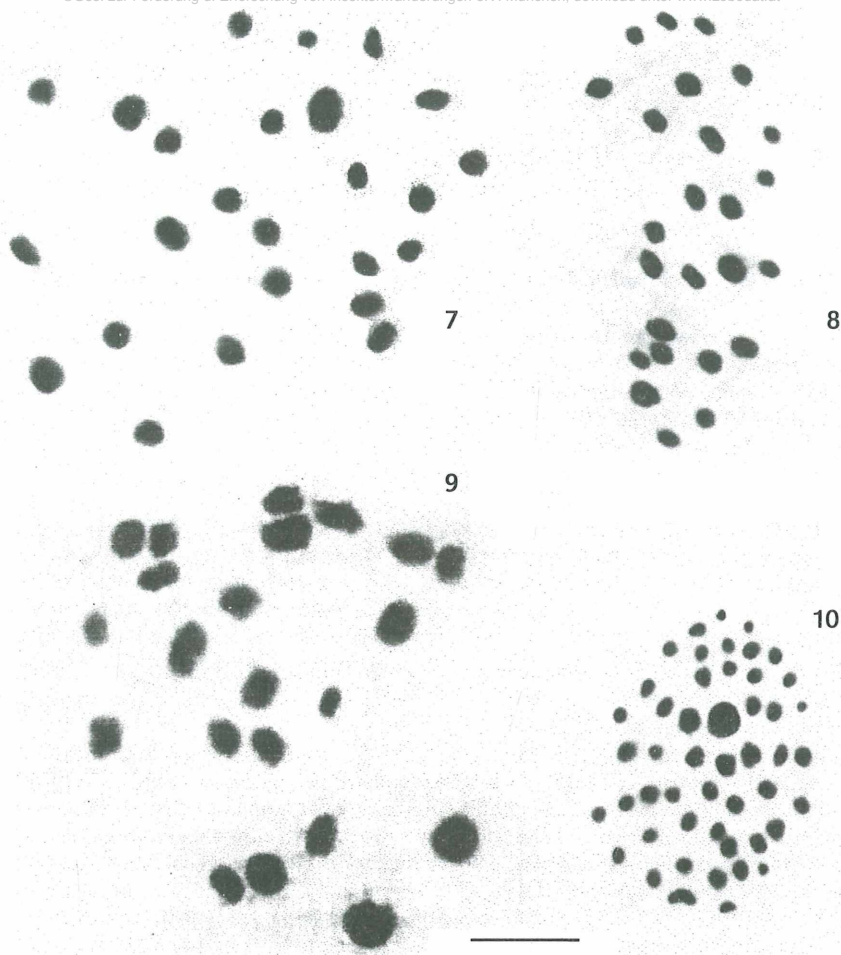


Fig. 9: *Agrodiaetus pierceae* LUKHTANOV & DANTCHENKO spec. nov.

Holotype ♂: No VL01L365 in MCZH, n = 22, Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH.

Late prometaphase I spermatocyte, squash preparation; n = 22.

Fig. 10: *A. surakovi sekercioglui* DANTCHENKO & LUKHTANOV spec. nov. (n = 50).

Holotype ♂: No VL01L196, n = 50, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH.

Weekly squashed M I preparation in which the bivalent positions are similar to that in intact cells. n = 50 (48 bivalents and 1 multivalents, probably tetravalent, indicated by arrow).

Ecology

The butterflies fly on relatively humid meadows in mountains from 400 up to 1500 m a.s.l. Flight period: from late June to the mid of August. The butterflies are associated with *Onobrychis* spec. of the *Heliobrychis* section which is probably the food plant of the larvae.

Etymology

Mr. SERGEI OVCHINIKOV was a driver of our *Agrodiaetus*-expedition to Turkey (2001).

2. *Agrodiaetus alcestis karacetinae* LUKHTANOV & DANTCHENKO **subspec. nov.**

Holotype ♂: specimen No 92024, n = 19, Turkey, Hakkari, Dez valley, 1500 m, 19 July 1992; leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS, in the collections of the Institute of Systematic and Population Biology (Zoological Museum), Amsterdam, the Netherlands. Paratypes: 2 ♂♂, Iran, Marand, n = 19, leg. H. DE LESSE; 8 ♂♂, Iran, N Hamadan, n = 19, leg. H. DE LESSE; 1 ♂, Iran, E Sanandadj, n = 19, leg. H. DE LESSE; all paratypes are in MNHN.

Description

Very similar to *A. alcestis alcestis* (ZERNY, 1932) and can be distinguished by the karyotype. The geographical variability of the wing pattern and coloration in populations from Turkey and Iran was described by DE LESSE (1961b).

Karyotype (fig. 3)

In the holotype the chromosome number n = 19 was found in all studied 53 MI cells (LUKHTANOV et al., 1998). In MI cells, all bivalent chromosomes formed a gradient row. The karyotype contained no exceptionally big or small bivalents.

In a single specimen of *A. alcestis alcestis* from Central Turkey (sample No 94036; Prov. Konya, Taskent, 1500–1600 m, 20.VII.1994) we have found n = 20 in 5 studied cells.

From the investigations of DE LESSE (1960a, b), LARSEN (1975) and our data it is clear that the populations of *A. alcestis* can be divided into two groups with different chromosome numbers. The western group has a stable chromosome number (n = 20) and contains the populations from Turkey (except south-eastern Turkey), Lebanon and Antilebanon. Only in very few specimens the karyotype with n = 21 occurs (DE LESSE, 1960b). As can be seen from the figures given in DE LESSE (1960b: figs 5c, 5d), this fact can be ascribed to a very small extra element, which occurs at the periphery of the metaphase plate and can best be treated as a B-chromosome. The oriental group has also a stable chromosome number n = 19 and contains the populations of Iran. The single specimen examined (our data) from south-eastern Turkey (Hakkari) belongs according to its chromosome number to the oriental subspecies. This is not surprising as in south-eastern Turkey more Iranian taxa are found which do not occur further to the West or the North in the other Turkish provinces (cf. HESSELBARTH, VAN OORSCHOT & WAGENER, 1995).

Differential diagnosis

The new subspecies differs from *A. alcestis alcestis* by the chromosome number n = 19. In the nominotypical subspecies the chromosome number n = 20 (with few exceptions of n = 21) was found.

Distribution

The karyotyped specimens of the new subspecies were collected in Hakkari, SE Turkey (our data) and in W Iran (DE LESSE, 1960b)

Etymology

Ms EVRIM KARACETIN, biologist from Middle East Technical University, Ankara, Turkey was a member of our expedition of 2001 to Eastern Turkey.

3. *Agrodiaetus damocles kanduli* DANTCHENKO & LUKHTANOV **subspec. nov.** (colour plate I, figs 1–4)

Holotype ♂: No VL01L180, n = 25, Turkey, Prov. Erzincan, Munzur Daglari Mts, Yildiz, 39°35'N, 39°57'E, 1700 m, 17.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: 3 ♂♂, No VL01L261, No VL01L277–278 Turkey, Prov. Erzincan, Munzur Daglari Mts, Yildiz, 39°35'N, 39°57'E, 1700 m, 17.VII.2001, A. DANTCHENKO leg., in MCZH.

Description

♂. Forewing length 15.0–16.2 mm.

Upperside: Ground colour is pure blue with veins slightly darkened distally. Discoidal, submarginal and antemarginal marking completely absent. Forewing with developed androconial scales. Inner part of fringes is light gray, outer part is white.

Underside: Ground colour is light gray. Bluish basal suffusion is not strong but clear prominent. Discoidal black spot well developed on forewings, on hindwings almost invisible. Post-discal spots of the forewings relatively large, on the hindwings very small. Submarginal and antemarginal marking strongly reduced, faintly discernible. White streak on hindwings well developed, slightly enlarged distally in holotype and in one paratype.

♀ unknown.

Karyotype (fig. 4)

In the holotype (sample No VL01L180) the chromosome number n = 25 was found in 15 studied MI cells. In the stage MI the karyotype includes two groups of bivalents: the first group consisting of 6 or 7 relatively large bivalents and the second group consisting of medium-sized and small bivalents. The bivalents of the second group gradually diminish in size.

The same chromosome number was found in *A. damocles rossicus* DANTCHENKO & LUKHTANOV, 1993 (LUKHTANOV et al., 1997) and in *A. larseni larseni* CARBONELL, 1994 from Lebanon (LARSEN, 1975; OLIVIER et al., 1999).

Differential diagnosis

The new subspecies is close to *A. damocles damocles* (HERRICH-SCHÄFFER, [1844]), *A. damocles rossicus* and *A. damocles krymaeus* (SHELJUZHKO, 1928) by the karyotype and the colour of fore- and hindwing upperside, but clearly differs by the basal blue dusting of the hindwing underside. The ground colour of the wing underside with brownish tint.

According to our mtDNA data set (KANDUL et al., in prep.), *A. damocles kanduli* is closely related to the allopatric taxa *A. damocles damocles*, *A. damocles rossicus*, *A. damocles*

krymaeus and to the sympatric taxon *A. altivagans* FORSTER, 1956. The latter species differs from *A. damocles kanduli* by the karyotype (LUKHTANOV & DANTCHENKO, 2002).

A. damocles kanduli is probably sympatric in distribution with *A. poseidon mesopotamicus* (STAUDINGER, 1892). It differs from that taxon by the black veins on the wing upperside.

Distribution

Known from the type-locality only.

Etymology

Mr. NIKOLAI KANDUL, student of Harvard University, an expert in the karyology of butterflies, was an active member in our *Agrodiaetus*-expedition, and accompanied us during our trip to Eastern Turkey in 2001.

4. *Agrodiaetus putnami* DANTCHENKO & LUKHTANOV spec. nov.

(colour plate I, figs 5–8)

Holotype ♂: No VL01L416 in MCZH, n = 26, Turkey, Prov. Erzurum, 8 km W Kayabasi, 39°51'N, 41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: 5 ♂♂, No VL01L417–421, Turkey, Prov. Erzurum, 8 km W Kayabasi, 39°51'N, 41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂, 2001–617, Turkey, Prov. Erzurum, 8 km W Kayabasi, 39°51'N, 41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in SPSU. 4 ♂♂ (n = 24–27), Agri ou Karakose (Turquie), route N km 15, 2.VIII.1958, H. DE LESSE leg., in MNHN.

Description

♂. Forewing length 17.2–18.6 mm.

Upperside: Ground colour is pure blue with whitish tint, slightly dusted by dark scales in outer part, veins not darkened. Discoidal, submarginal and antemarginal marking completely absent. Forewing with androconial scales. Inner part of fringes is dark gray, outer part is white in forewings, near pure white in hindwings.

Underside: Ground colour is gray with light brownish tint. Bluish basal suffusion is not strong but clearly prominent. Discoidal black spot well developed on forewings, on hindwings almost invisible. Postdiscal spots of the forewings relatively large, on the hindwings very small, clearly encircled with white. Submarginal and antemarginal marking strongly reduced, faintly discernible, more prominent in hindwings in Cu1–2A. White streak on hindwings well developed, not enlarged distally, uniformly in all specimens.

♀ unknown.

Karyotype (fig. 5)

In the holotype (sample No VL01L416) the chromosome number n = 26 was found in 10 studied MI cells. In the stage MI the karyotype includes two groups of bivalents: the first group consisting of 6 or 7 relatively large bivalents and the second group consisting of medium-sized and small bivalents. The bivalents of the second group gradually diminish in size. In the population from Agri (Turkey) DE LESSE (1963b) found the variability in the chromosome number from n = 24 up to n = 27.

Differential diagnosis

As it follows from the works published up to now (DE LESSE, 1963; KANDUL & LUKHTANOV, 1997; LUKHTANOV et al., 1998) and our unpublished data, *A. poseidon* (sensu HESSELBARTH, OORSCHOT & WAGENER, 1995) is karyotypically heterogeneous. It can be divided into two subgroups that, in our opinion, belonging to different species. Accurate analysis of the chromosome number demonstrates that differences between the subgroups are sufficiently high and discrete. One of the subgroups (*A. poseidon* s. str.) includes populations with relatively low chromosome number (from $n = 19$ to $n = 21$) with all bivalents of approximately the same size at the stage MI. Chromosome numbers $n = 22$ and $n = 23$ in a population of *A. poseidon* s. str. from Amasya were found by DE LESSE (1963b) as intraindividual occasional deviations from basic $n = 21$.

The second subgroup, to which we regard *A. putnami*, includes populations with higher chromosome numbers (from $n = 24$ to $n = 27$) and very different karyotype structure, which includes classes of large and relatively small chromosomes.

A. putnami differs from *A. damocles* and *A. larseni* by the non-darkened veins of the wing upperside. According to our mtDNA data set (KANDUL et al., in press), the taxa *A. damocles* and *A. putnami*, which have similar chromosome number and karyotype structure, are not closely related and belong to two different species-groups inside the genus *Agrodiaetus*.

Distribution

Turkey (Erzurum, Agri).

Etymology

The Putnam Expeditionary Fund of the Museum of Comparative Zoology, Harvard University sponsored our expeditions of 2000 and 2001 to Kazakhstan, Armenia, Ukraine and Turkey.

5. *Agrodiaetus bilgini* DANTCHENKO & LUKHTANOV spec. nov.

(colour plate I, figs 9–12)

Holotype ♂: No VL01Q140 in MCZH, $n = 25$, Turkey, Prov. Gümüşhane, 20 km S Torul, 40°23'N; 39°19'E; 1300 m, 13.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: 6 ♂♂, No VL01Q141–142, VL01Q145, VL01Q293, VL01Q306, VL01Q319, Turkey, Prov. Gümüşhane, 20 km S Torul, 40°23'N; 39°19'E; 1300 m, 13.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂, No VL01L119, Turkey, Prov. Gümüşhane, 25 km S Torul, 40°20'N, 39°18'E; 1400 m, 14.VII.2001, A. DANTCHENKO leg., in MCZH. 2 ♂♂ ($n = 25$), "Erzincan (Turquie) col rte Kelkit" (25 km N Erzincan), 2600, 5.VIII.1958 H. DE LESSE leg. in MNHN. 1 ♂ ($n = 24$), "Erzincan (Turquie) col rte Kelkit" (25 km N Erzincan), 2600, 5.VIII.1958 H. DE LESSE leg., in MNHN.

Description

♂. Forewing length: holotype 14.5 mm., paratypes: 13.0–15.0 mm (average 14.2 mm from 8 specimens).

Upperside: Ground colour is dark blue with clear violet tint, veins darkened distally, more on hindwings. Discoidal, submarginal and antemarginal marking completely absent. Inner part of fringes is dark gray, outer part is white.

Underside: Ground colour is gray, hindwings with fine brownish tint. Bluish basal suffusion is not strong but clearly prominent. Discoidal black spot well developed on forewings, on hindwings almost invisible. Postdiscal spots of the forewings relatively small, on the hindwings strong reduced. Submarginal and antemarginal marking reduced. White streak on hindwings well developed, not enlarged distally.

♀ unknown.

Karyotype (fig. 7)

In the holotype (sample No VL01Q140) in 5 studied prometaphase I cells, the number of bivalents was precisely determined as $n = 25$. All bivalents gradually diminish in size.

We include in the type series three specimens from Erzincan, which were karyotyped and determined by DE LESSE (1962) as "*A. actis pseudactis*". Mentioned specimens have a distinctive deep violet colour and obviously belong to the *sigberti-artvinensis* species-group. Of these three, two specimens have the chromosome number $n = 25$ and symmetric karyotype structure (DE LESSE, 1962). In the third specimen from Erzincan DE LESSE counted $n = 24$. However, on the picture of this karyotype (DE LESSE, 1962: 68, fig. 2e) one can see a very strange, large, dumb-bell-shaped element at the periphery of the metaphase plate. The unusual form and peripheral position of this dumb-bell-shaped element are in our opinion an evidence it is in reality a tetravalent, and the true chromosome number is $n = 25$.

Differential diagnosis

Agrodiaetus bilgini differs from phenotypically similar *A. artvinensis* CARBONELL, 1997 and *A. sigberti* OLIVIER, VAN DER POORTEN, PUPLESIENE, DE PRINS & WIEMERS, 2000 by the karyotype. *A. artvinensis* has $n=21$ (OLIVIER et al., 2000). *A. sigberti* has $n = 28-29$ (our data, see note below).

Distribution

Turkey (Gümüşhane, Erzincan).

Etymology

Prof. Dr. CAN BILGIN, biologist from Middle East Technical University, Ankara, Turkey helped us very much in organization of our expedition of 2001 to Eastern Turkey.

Note

The taxon *A. sigberti* OLIVIER, VAN DER POORTEN, PUPLESIENE, DE PRINS & WIEMERS, 2000 is known in early literature as *A. actis* (HERRICH-SCHÄFFER, [1851]) (for e.g. see: HESSELBARTH et al., 1995). According to OLIVIER et al. (2000), in reality another species was described by HERRICH-SCHÄFFER, ([1851]) under the name "*[Lycaena] actis* KAD." Here we accept this suggestion as a working hypothesis that must be tested in future.

We had karyotyped two specimens of *A. sigberti* (Turkey, Nigde province, Aladaglari, 15 km SE Çamardı, 1800–2100 m, St. 2009, 30.VII.1994, leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS) that were later included as paratypes in the type series of *A. sigberti*. In the specimen No 94/122 in numerous MI cells we could approximately count ca 28–29 bivalents. In a single MI plate the chromosome number was precisely determined as $n = 29$. In the specimen No 94/125 in 4 MI plates the number of bivalents was precisely determined as

$n = 28$ (fig. 6). The area of the first bivalent was 5–6 times as large as that of the last bivalent. The bivalents were oval or dumb-bell shaped and of gradually diminishing size.

6. *Agrodiaetus haigi* DANTCHENKO & LUKHTANOV spec. nov.
(colour plate I, figs 13–16)

Holotype ♂: No VL01L220, $n = 25$, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: ♂ (VL01L224), $n = 26$, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂ (VL01L340), $n = 25$, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂ (VL01L230), $n = 25$, Turkey, Prov. Van, Kurubas Geçidi, 2200 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂ (VL01L371), $n = 25$, Turkey, Prov. Van, Güseldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂ (No 92058), $n = 25$, Turkey, Prov. Van, 32 km NE Çatak, 2000–2200 m, 28.VII.1992, leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS, in the collections of the Institute of Systematic and Population Biology (Zoological Museum), Amsterdam, the Netherlands. 1 ♂ No 92043 $n = 25$, $n = 25+m$, Prov. Bitlis, Kuskunkiran Geçidi, 1900–2300 m, 26.VII.1992, leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS, in the collections of the Institute of Systematic and Population Biology (Zoological Museum), Amsterdam, the Netherlands.

Unkaryotyped paratypes: 5 ♂♂ (VL01L336–340) Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 7 ♂♂ (2001: 278–284), Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 8 ♂♂ (2001: 341–348), Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 5 ♂♂ (VL01L216–218, No VL01L221; No VL01L224), Turkey, Prov. Van, 34 km N Çatak, 22.VII.2001, A. DANTCHENKO leg., in MCZH. 3 ♂♂ (VL01L231, VL01L233–234), Turkey, Prov. Van, Kurubas Geçidi, 2200 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH. 2 ♂♂ (VL01L355, VL01L357), Turkey, Prov. Van, Güseldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♂ (2001–470), Turkey, Prov. Van, Güseldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in SPSU.

Description

♂. Forewing length: holotype 15.8 mm., paratypes: 15.0–16.8 mm (average 16.2 mm from 14 specimens).

Upperside: Ground colour is dark blue with light violet tint, veins not darkened. Discoidal, submarginal and antemarginal marking completely absent. Forewing with sex brand almost invisible. Inner part of fringes dark gray, outer part white in forewings, almost pure white in hindwings.

Underside: Ground colour is gray, hindwings with light brownish tint. Bluish basal suffusion is not strong but clear prominent. Discoidal black spot well developed on forewings, on hindwings almost invisible. Postdiscal spots of the forewings relatively large, on the hindwings very small, slightly encircled with white. Submarginal and antemarginal marking strongly reduced, faintly discernible. White streak on hindwings well developed, slightly enlarged distally.

♀ unknown.

Karyotype (fig. 8)

In the holotype (sample No VL01L220) in 8 studied prometaphase I cells and in 3 prometa-

phase cells, the number of bivalents was precisely determined as $n = 25$. The karyotype showed a graded series of bivalents.

The same chromosome number ($n = 25$) was found in following samples: VL01L230 (20 MI cells studied), VL01L340 (4 MI cells studied), VL01L230 (15 MI cells studied), VL01L371 (4 prometaphase I cells studied). In the sample VL01L224 in 15 studied MI cells from 3 different spermatocysts, the number of bivalents was determined as $n = 26$; the karyotype showed a graded series of bivalents.

The same data ($n = 25$ and $n = 25+m$ in the MI cells) were found recently in a population from Kuskunkiran Geçidi, Bitlis (LUKHTANOV et al., 1998, determined as "*firdussii pseudactis*").

Differential diagnosis

This new species is a geographical vicariant of *A. pseudactis* FORSTER, 1960. Phenotypically and according to our mtDNA data set (KANDUL et al., in press), these two species are closely related. The both species are associated with *Onobrychis cornuta* which is apparently the food plant of the larvae. The karyotype $n = 29$ was found by us in different localities of *A. pseudactis* from Armenia (LUKHTANOV & DANTCHENKO, 2002) and Turkey (LUKHTANOV & DANTCHENKO, unpublished), whereas *A. haigi* has $n = 25$ or $n = 26$.

Distribution

Turkey (Van, Bitlis).

Etymology

Prof. Dr. DAVID HAIG is a theoretical geneticist (Harvard University) involved in investigation of chromosome evolution in insects.

7. *Agrodiaetus pierceae* LUKHTANOV & DANTCHENKO spec. nov.

(colour plate I, figs 17–20)

Holotype ♂: No VL01L365 in MCZH, $n = 22$, Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: 9 ♂♂, No VL01L364, VL01L372–378, VL01L382, Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH. 7 ♂♂ (2001: 480–486), Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in SPSU. 2 ♂♂, No 92113–92114 ($n = 22$), Turkey, Prov. Van, Güzeldere Geçidi, 2650–2850 m, 4.–5.VIII.1992, leg. H. v. OORSCHOT, H. v. D. BRINK, D. v. D. POORTEN & W. DE PRINS, in the collections of the Institute of Systematic and Population Biology (Zoological Museum), Amsterdam, the Netherlands.

Description

♂. Forewing length: holotype 17.8 mm., paratypes: 16.2–18.5 mm (average 16.8 mm from 17 specimens).

Upserside: Ground colour is light blue with a strong metallic tint, outer part dusted by dark scales, veins strongly darkened distally. Fore costal area with white pubescence. Discoidal, submarginal and antemarginal marking completely absent. Forewing with sex brand. Inner part of fringes dark gray in forewings, light gray in hindwings, the outer part is white.

Underside: Ground colour is gray, hindwings with light brownish tint. Bluish basal suffusion is strong. Discoidal black spot well developed on forewings, on hindwings almost invisible. Post-discal spots of the forewings relatively large, on the hindwings very small, slightly encircled with white. Submarginal and antemarginal marking reduced, but clearly visible, more prominent in hindwings. White streak on hindwings well developed, in half of the type series enlarged distally.

♀. The females (according to pictures in HESSELBARTH et al., 1995: Taf. 119: 60, 65–66, 71–72).

Upperside: Ground colour medium brown with darker veins. Slight traces of light blue-green suffusion usually present on both wings. Discoidal spots clearly visible on both fore- and hindwings, and nearly always lighter rimmed. Submarginal pattern weak on forewings and well developed on hindwings, but always without orange coloring, typical for the *iphigenides*-group. Light brown lunules of submarginal hindwing pattern distally bordered by darker crescents and always containing dark brown outer submarginal spots. Fringes very light brownish gray on forewings, white on hindwings.

Underside: Ground colour of forewing light grayish brown with darkened base, hindwing darker and more brown. Basal suffusion green. Fringes light gray to white.

Illustrations

HESSELBARTH et al., 1995 (♀♀ Taf. 119: 60, 65–66, 71–72; ♂♂ Taf. 119: 57–58, 62–63, 69–70).

Karyotype (fig. 9)

In the holotype (sample VL01L365) in 7 studied metaphase II and in 3 prometaphase I cells, the haploid chromosome number was precisely determined as $n = 22$. In two paratype specimens (samples No 92113–92114) which were previously determined as "*A. s. (?huberti)*" (LUKHTANOV et al., 1998) the same karyotype was found. In MI all bivalents form a gradient series. The karyotype shows no extraordinary large or small bivalents.

Differential diagnosis

This new species is phenotypically very similar to *A. huberti*, but it differs strongly by the karyotype. The variable chromosome number from $n = 34$ up to $n = 37$ reliably estimated (our data) for several populations of *A. huberti* from Armenia (LUKHTANOV & DANTCHENKO, 2002) and Turkey (LUKHTANOV & DANTCHENKO, unpublished), to be compared to $n = 22$ for the specimens of *A. pierceae*. According to our mtDNA data set (KANDUL et al., in press), *A. pierceae* is closely related to *A. kendeveni* FORSTER, 1956 ($n = 16$) and *A. zarathustra neglectus* DANTCHENKO, 2000 ($n = 25$), not to *A. huberti*.

Notes

1. The population described above as new species was studied previously, the chromosome number was found to be $n = 22$ (LUKHTANOV et al., 1998). These data were not interpreted correctly at that time (HESSELBARTH et al., 1995: 734), probably, due to the lack of comparative karyology data for the typical population of morphologically closed species, such as *A. ninae* and *A. huberti*.

2. According to ECKWEILER & HÄUSER (1997), *A. huberti* could be treated as a synonym or a separate subspecies of *A. anticarmon*. However, after studying the type material, CARBONELL (1998b) found that *A. anticarmon* and *A. huberti* were very different phenotypically. This is the

reason why *A. rierceae* from the same locality cannot be treated as conspecific with *A. anticarmon*.

Distribution

Turkey (Van).

Etymology:

Prof. Dr. NAOMI PIERCE is a biologist from Harvard University, famous expert in the biology of the Lycaenidae.

8. *Agrodiaetus surakovi sekercioglu* DANTCHENKO & LUKHTANOV **subspec. nov.** (colour plate I, figs 21–24)

Holotype ♂: No VL01L196, n = 50, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH.

Paratypes: 4 ♂♂, 1 ♀ (VL01L334, VL01L335, VL01L202, VL01L206, VL01L207), Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH. 1 ♀, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in SPSU. 4 ♂♂ (2001: 360, 363, 367, 383), Turkey, Prov. Van, 34 km N Çatak, 21.VII.2001, A. DANTCHENKO leg., in SPSU.

Description

♂. Forewing length: holotype 18.0 mm., paratypes: 16.9–18.0 mm, (average 16.2 mm from 8 specimens).

Upperside: Ground colour is blue with a light metallic tint, outer part dusted by dark scales, veins strong darkened distally. Fore costal area with white pubescence. Discoidal, submarginal and antemarginal marking completely absent. Inner part of fringes is dark gray in forewings, light gray in hindwings outer part is white.

Underside: Ground colour is gray with light brownish tint. Bluish basal suffusion is strong. Discoidal black spot well developed on forewings, on hindwings almost invisible. Postdiscal spots of the forewings very large, especially the spot in the cell Gu1–Cu2 which is of the same size as the discal spot, postdiscal spots on the hindwings small, all spots encircled with white. Submarginal and antemarginal marking strong reduced on forewings, prominent in hindwings. White streak on hindwings well developed and sharp, not enlarged distally.

♀ Forewing length: 18.4–18.6 mm.

Upperside: Ground colour is dark brown. Discoidal spot clearly prominent, submarginal and antemarginal marking completely absent. Fringe is light brown, in apex of the forewings almost white.

Underside: General design as in the males but ground colour is brown with a dirty tint. Bluish basal suffusion clearly visible, not strong.

Karyotype (fig. 10)

In the holotype (sample VL01L196) the bivalent number n = 50 was found in 5 studied MI cells from one spermatocyst. In another spermatocyst, (one studied MI cell) we have found 48 bivalents and 1 multivalents, probably tetravalent. Thus, the haploid chromosome number of this specimen is n = 50. In the intact and in weekly squashed MI cells, the small bivalents formed a

regular circle or oval, whereas the large bivalent occupied central position of the metaphase plate.

A very similar karyotype was found in *A. surakovi surakovi* from the type locality (LUKHTANOV & DANTCHENKO, 2002).

Differential diagnosis

The butterflies of *A. surakovi* from Lake Van (Turkey) were earlier determined as *A. carmon* (HESSELBARTH et al., 1995). However, *A. surakovi sekercioglu* strongly differs in the number of chromosomes from both *A. carmon carmon* HERRICH-SCHÄFFER, [1851] ($n = 81-82$, DE LESSE, 1963a and our unpublished data) and *A. carmon munzuricus* ROSE, 1978 ($n = ca\ 80$, LUKHTANOV & DANTCHENKO, unpublished). Compared to *A. surakovi surakovi* DANTCHENKO & LUKHTANOV, 1994 the new subspecies clearly differs by the darker suffusion on the wings' upper side in the males and the specific dirty brown ground colour of the females. The ground colour of the females of the nominotypical subspecies is brown with a warm chocolate tint.

Distribution

SE Turkey (Van).

Note

New karyological data obtained (LUKHTANOV & DANTCHENKO, in prep.) show clearly, that the taxa *carmon*, *schuriani*, *munzuricus* and *surakovi*, treated until recently as conspecific, belong in reality to quite different complexes.

According to our new data the *carmon*-complex consist at least of two species: *carmon* and *surakovi*.

Most probably all the specimens from the East-Turkey populations, determined earlier as *A. carmon*, belong to *A. surakovi sekercioglu*.

Due to morphology and distribution the taxon *schuriani* has to be placed into the *carmon*-complex.

Etymology

Mr. CAGAN HAKKI SEKERCIOGLU (Stainford University, USA) was an active member in our *Agrodiaetus*-expedition, and accompanied us during our trip to Eastern Turkey in 2001.

Acknowledgements

We thank Prof. Dr. NAOMI PIERCE (Harvard University), whose friendly inspiration we felt all the time during our *Agrodiaetus*-trip to East Turkey.

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Explanation of colour plate I (p. 225):

- Figs 1–4: *Agrodiaetus damocles kanduli* DANTCHENKO & LUKHTANOV subspec. nov.
Holotype ♂: No VL01L180, n = 25, Turkey, Prov. Erzincan, Munzur Daglari Mts, Yildiz, 39°35'N, 39°57'E, 1700 m, 17.VII.2001, A. DANTCHENKO leg., in MCZH.
- Figs 5–8: *Agrodiaetus putnami* DANTCHENKO & LUKHTANOV spec. nov.
Holotype ♂: No VL01L416 in MCZH, n = 26, Turkey, Prov. Erzurum, 8 km W Kayabasi, 39°51'N, 41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in MCZH.
- Figs 9–12: *Agrodiaetus bilgini* DANTCHENKO & LUKHTANOV spec. nov.
Holotype ♂: No VL01Q140 in MCZH, n = 25, Turkey, Prov. Gümüşhane, 20 km S Torul, 40°23'N; 39°19'E; 1300 m, 13.VII.2001, A. DANTCHENKO leg., in MCZH.
- Figs 13–16: *Agrodiaetus haigi* DANTCHENKO & LUKHTANOV spec. nov.
Holotype ♂: No VL01L220, n = 25, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH.
- Figs 17–20: *Agrodiaetus pierceae* LUKHTANOV & DANTCHENKO spec. nov.
Holotype ♂: No VL01L365 in MCZH, n = 22, Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH.
- Figs 21–24: *Agrodiaetus surakovi sekercioglui* DANTCHENKO & LUKHTANOV subspec. nov.
Holotype ♂: No VL01L196, n = 50, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH.

1	3	5	7
2	4	6	8
9	11	13	15
10	12	14	16
17	19	21	23
18	20	22	24

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Colour plate I

LUKHTANOV, V. A. & A. V. DANTCHENKO: Descriptions of new taxa of the genus *Agrodiaetus* HÜBNER, [1822] based on karyotype investigation (Lepidoptera, Lycaenidae). – *Atalanta* **33** (1/2): 81–107.

Figs 1–4: *Agrodiaetus damocles kanduli* DANTCHENKO & LUKHTANOV subspec. nov.

Holotype ♂: No VL01L180, n = 25, Turkey, Prov. Erzincan, Munzur Daglari Mts, Yildiz, 39°35'N, 39°57'E, 1700 m, 17.VII.2001, A. DANTCHENKO leg., in MCZH.

Figs 5–8: *Agrodiaetus putnami* DANTCHENKO & LUKHTANOV spec. nov.

Holotype ♂: No VL01L416 in MCZH, n = 26, Turkey, Prov. Erzurum, 8 km W Kayabasi, 39°51'N, 41°47'E, 1900 m, 28.VII.2001, A. DANTCHENKO leg., in MCZH.

Figs 9–12: *Agrodiaetus bilgini* DANTCHENKO & LUKHTANOV spec. nov.

Holotype ♂: No VL01Q140 in MCZH, n = 25, Turkey, Prov. Gümüşhane, 20 km S Torul, 40°23'N; 39°19'E; 1300 m, 13.VII.2001, A. DANTCHENKO leg., in MCZH.

Figs 13–16: *Agrodiaetus haigi* DANTCHENKO & LUKHTANOV spec. nov.

Holotype ♂: No VL01L220, n = 25, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 22.VII.2001, A. DANTCHENKO leg., in MCZH.

Figs 17–20: *Agrodiaetus pierceae* LUKHTANOV & DANTCHENKO spec. nov.

Holotype ♂: No VL01L365 in MCZH, n = 22, Turkey, Prov. Van, Güzeldere Geçidi, 2700 m, 24.VII.2001, A. DANTCHENKO leg., in MCZH.

Figs 21–24: *Agrodiaetus surakovi sekercioglu* DANTCHENKO & LUKHTANOV subspec. nov.

Holotype ♂: No VL01L196, n = 50, Turkey, Prov. Van, 34 km N Çatak, 2100 m, 20.VII.2001, A. DANTCHENKO leg., in MCZH.

1	3	5	7
2	4	6	8
9	11	13	15
10	12	14	16
17	19	21	23
18	20	22	24

Colour plate I

